

1        **CLAIMS**

2        Having thus described our invention, what we claim as new and desire to secure  
3        by Letters Patent is as follows:

- 4        1. A method comprising accessing virtual iSCSI storage, including the steps of:
- 5        defining at least one physical logical unit number (LUN) on a physical storage  
6        device having an device IP address;
- 7        associating a unique TCP port number with each said at least one physical LUN;
- 8        replacing a first LUN identifier specified in said iSCSI command with a second  
9        LUN identifier associated with said given TCP port number;
- 10       establishing a unique IP address at which a virtual LUN is accessed from a host;
- 11       identifying a block TCP port number with each block range of said virtual LUN;
- 12       mapping a SCSI command to one or more iSCSI/TCP connections having said  
13       unique IP address and the block TCP port number identified with said each block  
14       range referenced by said SCSI command; and
- 15       substituting said unique IP address and said block TCP port number with said  
16       device IP address and said given TCP port number on packets between said host  
17       and said storage devices.

2025-10-20 10:00:00

1 2. A method as recited in claim 1, further comprising forming a correspondence  
2 between an iSCSI command received on a given TCP port with a particular  
3 physical LUN associated with said given TCP port.

4 3. A method as recited in claim 1, wherein said step of accessing results in  
5 forming TCP/iSCSI connections between the host and one or more physical LUNs  
6 without terminating said TCP/iSCSI connection at an intermediate gateway  
7 between said host and said device.

8 4. A method as recited in claim 1, wherein the step of mapping includes  
9 converting a single SCSI command to one iSCSI connection per block range  
10 accessed.

11 5. A method as recited in claim 1, wherein the step of substituting includes  
12 looking up a local substitution map at a gateway having a mapping between  
13 incoming destination IP address and port number and an outgoing device IP  
14 address and port number.

15 6. A method as recited in claim 1, where a migration of a physical LUN from a  
16 source storage device to a target storage device requires only updating said  
17 substitution map to reflect new location of said physical LUN.

18 7. A method as recited in claim 1, further comprising:

19 employing IPSec processing support at the host;

20 employing IPSec processing support at a gateway between said host and said  
21 storage device; and

1 forming an IPSec tunnel between said host and said gateway;

2 8 10. A method comprising providing support at a physical storage device for  
3 accessing virtual iSCSI storage, including the steps of:

4 defining at least one physical logical unit (LUN) on the physical storage device  
5 having an device IP address;

6 associating a unique TCP port number with each said at least one physical LUN;  
7 and

8 replacing a first LUN identifier specified in said iSCSI command with a second  
9 LUN identifier associated with said given TCP port number.

10 9 11. A method comprising providing support at a host for accessing virtual iSCSI  
11 storage, including the steps of:

12 establishing a unique IP address at which a virtual LUN is accessed from the host;

13 identifying a block TCP port number with each block range of said virtual LUN;  
14 and

15 mapping a SCSI command to one or more iSCSI/TCP connections having said  
16 unique IP address and the block TCP port number identified with said each block  
17 range referenced by said SCSI command;

1 /0 ~~12~~. A method comprising providing support at an intermediate gateway device  
 2 between a host and a storage device for accessing virtual iSCSI storage, including  
 3 the step of substituting a host-specified IP address and a host-specified TCP port  
 4 number with a device IP address and a TCP port number within that device  
 5 according to a substitution table describing the virtual to physical storage mapping  
 6 for incoming packets before forwarding said packets.

7 1/ ~~13~~. An apparatus comprising:

8 a conversion module at a physical storage device for accessing virtual iSCSI  
 9 storage, coupled to means for defining at least one physical logical unit (LUN) on  
 10 the physical storage device having an device IP address; and coupled to means for  
 11 associating a unique TCP port number with each said at least one physical LUN;  
 12 said conversion module to replace a first LUN identifier specified in said iSCSI  
 13 command with a second LUN identifier associated with said given TCP port  
 14 number.

15 12 ~~14~~. An apparatus at a physical storage device for accessing virtual iSCSI storage,  
 16 comprising:

17 means for replacing a first LUN identifier specified in an iSCSI command with a  
 18 second LUN identifier associated with a given TCP port number included in said  
 19 iSCSI command;

20 means for defining at least one physical logical unit (LUN) on the physical  
 21 storage device having an device IP address; and

1 means for associating a unique TCP port number with each said at least one  
2 physical LUN.

3 ~~13~~ 15. An apparatus comprising a virtualization module at a host for accessing  
4 virtual iSCSI storage, said virtualization module includes:

5 means for establishing a unique IP address at which a virtual LUN is accessed  
6 from the host;

7 means for identifying a block TCP port number with each block range of said  
8 virtual LUN; and

9 means for mapping a SCSI command to one or more iSCSI/TCP connections  
10 having said unique IP address and the block TCP port number identified with said  
11 each block range referenced by said SCSI command.

12 ~~14~~ 16. An apparatus comprising a virtualization module at a host for accessing virtual  
13 iSCSI storage, said virtualization module includes:

14 a control module establishing a unique IP address at which a virtual LUN is  
15 accessed from the host, and for identifying a block TCP port number with each  
16 block range of said virtual LUN; and

17 a driver module for mapping a SCSI command to one or more iSCSI/TCP  
18 connections having said unique IP address and the block TCP port number  
19 identified with said each block range referenced by said SCSI command.

20 ~~15~~ 17. An apparatus comprising:

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1 an address translation module at an intermediate gateway device between a host  
2 and a storage device for accessing virtual iSCSI storage, said address translation  
3 module having a substitution table describing a virtual to physical storage  
4 mapping, said address translation module to replace a host-specified IP address  
5 and a host-specified TCP port number with a device IP address and a TCP port  
6 number within said intermediate gateway device according to the substitution  
7 table for incoming packets before forwarding said incoming packets.

8 ~~18~~ 18. An apparatus at an intermediate gateway device between a host and a storage  
9 device for accessing virtual iSCSI storage,  
10 said intermediate gateway device having a a substitution table, said substitution  
11 table describing a virtual to physical storage mapping of IP addresses and TCP  
12 port numbers; said apparatus comprising:

13 means for replacing a host-specified IP address and a host-specified TCP port  
14 number, with an IP address and a TCP port number of the storage device, within  
15 said intermediate gateway device, according to the substitution table for incoming  
16 packets before forwarding said incoming packets.

17 ~~19~~ 19. An article of manufacture comprising a computer usable medium having  
18 computer readable program code means embodied therein for causing accessing  
19 virtual iSCSI storage,, the computer readable program code means in said article  
20 of manufacture comprising computer readable program code means for causing a  
21 computer to effect the steps of claim 1.

22 ~~20~~ 20. A program storage device readable by machine, tangibly embodying a  
23 program of instructions executable by the machine to perform method steps for

1 accessing virtual iSCSI storage,, said method steps comprising the steps of claim  
2 1..

3 19 ~~21~~ A computer program product comprising a computer usable medium having  
4 computer readable program code means embodied therein for causing LUN  
5 identifier substitution, the computer readable program code means in said  
6 computer program product comprising computer readable program code means  
7 for causing a computer to effect the functions of claim 13.

8 20 ~~22~~ A computer program product comprising a computer usable medium having  
9 computer readable program code means embodied therein for causing LUN  
10 identifier substitution, the computer readable program code means in said  
11 computer program product comprising computer readable program code means  
12 for causing a computer to effect the functions of claim 14.

13 21 ~~23~~ A computer program product comprising a computer usable medium having  
14 computer readable program code means embodied therein for causing SCSI  
15 command mapping, the computer readable program code means in said computer  
16 program product comprising computer readable program code means for causing  
17 a computer to effect the functions of claim 15.

18 22 ~~24~~ A computer program product comprising a computer usable medium having  
19 computer readable program code means embodied therein for causing SCSI  
20 command mapping, the computer readable program code means in said computer  
21 program product comprising computer readable program code means for causing  
22 a computer to effect the functions of claim 16.

1 23 25. A computer program product comprising a computer usable medium having  
2 computer readable program code means embodied therein for causing address  
3 substitution, the computer readable program code means in said computer  
4 program product comprising computer readable program code means for causing  
5 a computer to effect the functions of claim 17.

6 24 26. A computer program product comprising a computer usable medium having  
7 computer readable program code means embodied therein for causing address  
8 substitution, the computer readable program code means in said computer  
9 program product comprising computer readable program code means for causing  
10 a computer to effect the functions of claim 18.

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